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ABSTRACT

This action research project described strategies for improving student motivation and achievement in mathematics through multiple intelligences. The targeted population consisted of kindergarten, third, fourth, and fifth grade students located in two major Midwestern cities. Documentation proving low student motivation and achievement in mathematics included the following: preschool screening and kindergarten orientation testing, parent and student surveys, checklists, traveling portfolios, previous report card grades, beginning of the year math tests, and student participation. Probable cause data indicated that students learned best when instruction was geared to their multiple intelligences. Too often, multiple intelligences strategies were lacking, thus causing underachievement in mathematics. Math interest was not inherent in some students. Poor attitudes in mathematics were likely to foster lower student achievement. Research indicates that students have an inability to transfer math concepts into real life situations. Review of literature for possible solutions communicated the need for non-traditional teaching strategies. Students seemed to exhibit higher achievement and greater enthusiasm when able to explore different learning styles. Teaching to Howard Gardner's eight multiple intelligences made instruction and learning more meaningful to students. Post-intervention data indicated a general trend toward an increase in student motivation and positive attitude through the use of multiple intelligences strategies. Improvements were noted in student participation and student enthusiasm during mathematics. (Contains 36 references.) (Author/MM)

IMPROVING STUDENT MOTIVATION AND ACHIEVEMENT IN MATHEMATICS THROUGH TEACHING TO THE MULTIPLE INTELLIGENCES

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An Action Research Project Submitted to the Graduate Faculty of the

School of Education in Partial Fulfillment of the

Requirements for the Degree of Master of Arts in Teaching and Leadership

Saint Xavier University & SkyLight Professional Development

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This action research project described strategies for improving student motivation and achievement in mathematics through multiple intelligences. The targeted population consisted of kindergarten, third, fourth, and fifth grade students located in two major midwestern cities. Documentation proving low student motivation and achievement in mathematics included the following: preschool screening and kindergarten orientation testing, parent and student surveys, checklists, traveling portfolios, previous report card grades, beginning of the year math tests, and student participation.

Probable cause data indicated that students learned best when instruction was geared to their multiple intelligences. Too often, multiple intelligence strategies were lacking, thus causing underachievement in mathematics. Math interest was not inherent in some students. Poor attitudes in mathematics were likely to foster lower student achievement. Research indicates that students have an inability to transfer math concepts into real life situations.

Review of literature for possible solutions communicated the need for non-traditional teaching strategies. Students seemed to exhibit higher achievement and greater enthusiasm when able to explore different learning styles. Teaching to Howard Gardner's eight multiple intelligences made instruction and learning more meaningful to students.

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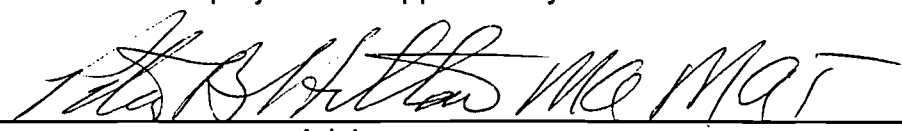

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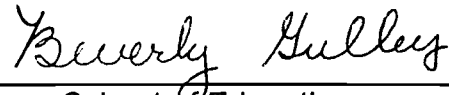

Dean, School of Education

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CHAPTER 1

PROBLEM STATEMENT AND CONTEXT

General Statement of the Problem

The students of the targeted kindergarten, third, fourth, and fifth grade classes are exhibiting lower than expected student motivation and achievement in math. Evidence for the existence of the problem includes chapter test scores, teacher observation of low time on task, limited work completion, and state standardized test scores.

Immediate Problem Context

Site A

The school is located in a suburb less than one mile away from a major midwestern city. The total enrollment is 342 with an average class size of 27.5 students. Of the 342 students, 62.9% is Hispanic, 36.3% is White, 0.6% is Asian/Pacific Islander, and 0.3% is Black. Students from low income families comprise 52.3% of the population. Twenty-seven and one half percent of the students have limited English proficiency. The school has an attendance rate of 94.7% with a mobility rate of 30.4%.

The average teaching experience is 13.8 years with 50.8% teaching with a bachelors degree and 49.2% teaching with a masters degree or above. The pupil teacher ratio is 19.2 to 1. The average teaching salary is $45,711 with the average

administrator's salary being $82,938. The instructional expenditure per pupil is $3,906. (School Report Card 2000)

The school has a variety of programs to service the needs of the students. Support personnel include a Title I teacher, a full time reading teacher, a speech teacher, bilingual teachers, occupational and physical therapists, and a social worker. Support services consist of bilingual programs, pupil service teams, a gifted program, special education programs for the learning disabled, behavior disordered, educable mentally handicapped, and early childhood intervention.

The weekly time devoted for teaching instruction is as follows: language arts for 450 minutes, math for 250 minutes, science for 200 minutes, social studies for 200 minutes, health for 80 minutes, physical education for 90 minutes, art for 40 minutes, music for 60 minutes, computer for 40 minutes, and library services for 40 minutes. The school is a two-story brick building with two stairwells. It has a gymnasium serving as a multi-purpose room, a media/technology center, an art/music room, student and faculty bathrooms on both floors, and a faculty lounge. There are 25 rooms used for instructional purposes. One main office provides secretarial, administrative, and health services for the school.

Site B

The school is located in a suburb fourteen miles outside of a major midwestern city. The total enrollment is 382 with an average class size of 23 students. Of the 382 students, 77% is White, 13.6% is Black, 6.8% is Hispanic, and 2.6% is Asian/Pacific Islander. Students from low income families comprise 3.1% of the population. Two and

one tenth percent of the students have limited English proficiency. The school has an attendance rate of 96.7% and a mobility rate of 6.3%.

The average teaching experience is 14.1 years with 59% teaching with a bachelors degree and 41% teaching with a masters degree or above. The pupil teacher ratio is 17.5 to 1. The average teaching salary is $42,322 while the average administrator's salary is $79,784. The instructional expenditure per pupil is $3,894. (School Report Card 2000)

Support personnel include a full time reading teacher, a speech teacher, bilingual teachers, occupational and physical therapists, and a social worker. Support services consist of a bilingual program, a student support network, a homework support service, a gifted program, special education for learning disabled, behavior disordered, and educable mentally handicapped.

The weekly time devoted for teaching instruction is as follows: language arts for 450 minutes, math for 250 minutes, science for 200 minutes, social studies for 200 minutes, health for 80 minutes, physical education for 140 minutes, art for 60 minutes, music for 45 minutes, computer for 40 minutes, and library services for 30 minutes. The school is a two-story brick building with four stairwells. It has a gymnasium serving as a multi-purpose room, a cafeteria, a media/technology center, an art room, a music room, a band room, student and faculty bathrooms on both floors, a teachers' work room, and a faculty lounge. There are 30 rooms used for instructional purposes. There is one main office providing secretarial and administrative services. There is one room designated for health service needs.

Site C

The school is located in a suburb less than one mile away from a major midwestern city. The total enrollment is 333 with an average class size of 23.5 students. Of the 333 students, 78.4% is White, 20.2% is Hispanic, .9% Black, and .6% is Asian/Pacific Islander. Students from low income families comprise 21.6% of the population. Five and eight tenths percent of the students have limited English proficiency. The school has an attendance rate of 95% with a mobility rate of 14.3%.

The average teaching experience is 13.8 years with 50.8% teaching with a bachelors degree and 49.2% teaching with a masters degree or above. The pupil teacher ratio is 19.2 to 1. The average teaching salary is $45,711 with the average administrator's salary being $82,938. The instructional expenditure per pupil is $3,906. (School Report Card 2000)

The school has a variety of programs to service the needs of the students. Support personnel include a Title I teacher, a full time reading teacher, a speech teacher, bilingual teachers, occupational and physical therapists, and a social worker. Support services consist of bilingual programs, pupil service teams, a gifted program, special education programs for the learning disabled, behavior disordered, educable mentally handicapped, and early childhood intervention.

The weekly time devoted for teaching instruction is as follows: language arts for 225 minutes, math for 225 minutes, science and health for 125 minutes, social studies for 175 minutes, physical education for 70 minutes, art for 40 minutes, music for 30 minutes, computer for 40 minutes, and library services for 30 minutes. The school is a two-story brick building with four stairwells. It has a gymnasium serving as a multi-purpose room,

a media/technology center, an art/music room, student and faculty bathrooms on both floors, and a faculty lounge. There are 26 rooms used for instructional purposes. One main office provides secretarial, administrative, and health services for the school. The surrounding community information will be identical for site A and site C.

The Surrounding Community

Site A and Site C

Site A and Site C are in a well established community drawing its population from a wide range of ethnicities. The original eastern European culture is changing with the rapid increase in the Hispanic population. A melting pot of American pride can be found in this neighborhood. The community is served by two school districts. Strict boundaries ensure commitment to neighborhood schools. These schools are two of seven schools in the district, and while most students walk to school, buses are provided for special transportation purposes. The schools are feeders to two local public high schools. Housing values vary greatly depending on location within the district. The home values range from $90,000 to $170,000. Neat lawns and tidy houses line these city blocks. Two park districts and a recreation department service the community. The districts provide a wide variety of child centered programs including pools with swimming instruction, sport opportunities, summer camp programs, leisure activities, and numerous well maintained parks. The community has a library with extensive resources, a YMCA, a SOKOL gymnastics organization, and various cultural centers. Numerous churches in the community represent various Christian religions. Job opportunities available are industrial, medical, managerial, technical, factory, educational, and recreational.

Site B

This school services a community surrounded by a cemetery, a forest preserve, an expressway, and railroad tracks. Major businesses are seldom attracted to this area because of this isolation. This community provides a small town feeling and has residents that date back several generations. Site B is one of three schools in the district. It is located in the northwestern section of the community. The majority of the students are bused to school because they would have to cross major intersections. When students leave the district, 20% of the graduating class attends the local public high school, while the remaining 80% chooses to go to the local private or parochial schools. The median home price is $171,276. Homes and properties are meticulously cared for throughout the neighborhood. One park district provides a wide variety of child centered programs including pools, sport opportunities, summer camp programs, leisure activities, numerous well maintained parks, and several other child care facilities. The community has a library with extensive resources. Numerous churches in the community represent various religious denominations. Job opportunities available are industrial, medical, managerial, technical, factory, educational, and recreational.

National Context of the Problem

Student motivation and achievement in math is a continuing concern among the general public and America's educators. The controversy lies in what solutions can be found to improve motivation and achievement.

Mathematics instruction needs to move from common practices of the past. Too often mathematics instruction focuses on rote drill, practice, and memorization of facts. These practices make mathematics very monotone. Many students do not have an

inherent interest in mathematics (Lesser, 2000, p.372). Teachers are struggling to develop new and innovative teaching practices to increase motivation in all students.

It is possible that the lack of student motivation in mathematics is in direct correlation to the lack of teacher motivation in mathematics. Teachers who present a negative tone while teaching mathematics will transfer those feelings to their students. These attitudes are apparent in teachers' statements as cited by the following, "I hate math! I couldn't learn it, and I can't teach it!", "I don't see why I have to teach math. I never could do it when I was in school!", and "I hated math in school...and my feelings haven't changed since" (Cornell, 1999, p.225). Teacher attitudes in mathematics have a direct impact on student motivation and thus achievement in mathematics.

There are many artifacts that show evidence that students are having difficulty solving mathematical problems. Student difficulty is exhibited in low test scores, teacher observation of weak problem solving processes, and a lack of confidence and transfer as reflected in their math journals (Roti, Trahey, Zerafa, 2000, p.1).

"President's report: . . . Building bridges of mathematical understanding for all children" (Price, 1996, p.603). This statement is the start of strong evidence showing the need for more in depth mathematics instruction and the need for mathematics across all disciplines, fostering transfer to real life situations. Results from the Third International Math and Science Study indicate,

> Math instruction in the U.S. can be characterized as a mile wide and an inch deep. That is, it sips many dozens of topics, but pauses little to drink of their essences. In general, U. S. students' number sense lagged behind the average of other countries mainly because

> focus on procedures takes precedence over true math thinking and problem solving in classrooms (as cited by Wahl, 2001, p.1).

A stronger emphasis on connecting mathematics to other disciplines is necessary for students to realize how the world relies on mathematics. Students are unable to connect mathematics to the real world because pieces of mathematics are often taught in separate compartments. The National Council of Teachers of Mathematics (NCTM) realizes the need to change the methods of mathematics instruction to enable students to meet the challenges of their future (Price, 1996, p.603).

CHAPTER 2

PROBLEM DOCUMENTATION

Problem Evidence

The following information, tables, and graphs depict low student motivation and achievement in mathematics. Data was collected from traveling portfolios, grade level tests, report cards, parent and student attitudinal surveys, and student entrance assessments. After analysis of these results, there is apparent evidence of low student motivation and achievement in mathematics.

Table 1

Site A1 Preliminary Data Collection/24 Students

Grading Scale	Traveling Portfolio Pre	Grade Level Test Pre	Report Card Average Pre
A	3	0	0
B	5	1	14
C	3	3	4
D	2	4	0
F	3	15	0
Information Unavailable	8	1	6

The traveling portfolio consisted of the end of the year mathematics test from the second grade. The testing results are evenly dispersed among the grading scale. The grade level test administered in the fall targeted the concepts that the students would be learning during the intervention period. The following data is based on the 24 students from Site A1. Three students received an A, five received a B, three received a C, two received a D, and three received an F on the second grade test. There was no information available for eight students. Zero students received an A, one student received a B, three students received a C, four students received a D, and 15 students received an F on the beginning of the year third grade mathematics test. There was no information available for one student. The high numbers at the lower end of the scale could be due to two factors. There was a degree of unfamiliarity with the concepts being tested. Also some students may have had difficulty retaining information from the previous year. The report card average came from second grade. Zero students received an A, 14 students received a B, four students received a C, and none of the students received a D or an F. There was no information available for six students. Looking at the two tests in Table 1, there is no correlation between the report card average and the testing percentages. This leads to an assumption that report card grades are very subjective at the primary level. At the primary level, effort is a big consideration when considering the final report card grades.

Table 2

Site A2 Preliminary Data Collection/21 Students

Grading Scale	Traveling Portfolio Pre	3rd Grade Level Test Pre	Report Card Average Pre
A	1	1	5
B	2	4	5
C	3	7	4
D	2	1	3
F	9	8	1
Information Unavailable	4	0	3

The traveling portfolio consisted of the end of the year mathematics test from the third grade. One student received an A, two students received a B, three students received a C, two students received a D, and nine students received an F. There was no information available for four students. The testing results showed a very large percentage at the failing level. Due to the number of students at the lower end of the scale, the third grade level test was administered. This test took the place of the fourth grade entry-level exam. One student received an A, four students received a B, seven students received a C, one student received a D, and eight students received an F. Their report card averages were based on the grade reports from third grade. Five students received an A, five students received a B, four students received a C, three students received a D, and one student received an F. There was no information available for three students. Looking at the two tests in Table 2, there is only a small degree of

correlation between the report card average and the testing percentages. This seems to reiterate the fact that report card grades remain subjective.

Table 3

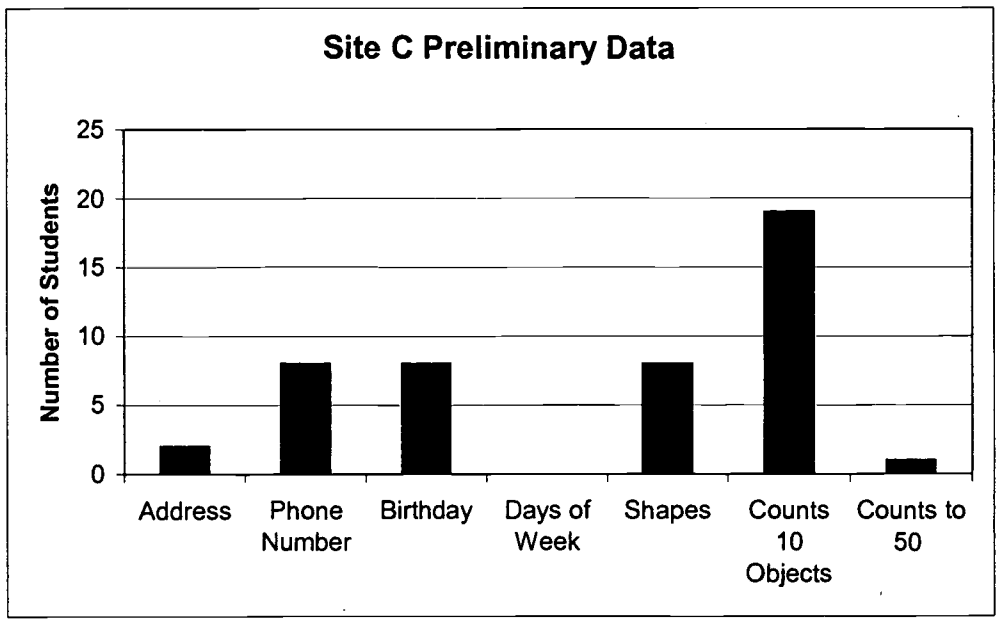
Site B Preliminary Data Collection/16 Students

Grading Scale	Grade Level Test Pre	Report Card Average Pre
A	0	3
B	1	9
C	4	4
D	4	0
F	7	0
Information Unavailable	0	0

The grade level test administered in the fall targeted the concepts that the students were exposed to the previous year. Zero students received an A, one student received a B, four students received a C, four students received a D, and seven students received an F. The higher numbers at the lower end of the scale could be due to two factors. There was a degree of unfamiliarity with the concepts being tested. Also some students may have had difficulty retaining information from the previous year. The report card average came from fourth grade. Three students received an A, nine students received a B, four students received a C, and none of the students received a D or an F. Looking at the test and report card, there is no correlation between the report card average and the testing percentages.

Figure 1

Site C Preliminary Data Collection/21 Students



Students entering kindergarten at Site C had a strong background in counting various objects. Looking at the table it seems apparent that there are strong weaknesses in all other areas. However, the testing showed that many of the students did have a concept of counting to at least 29. Almost all of the students were able to name half of the required four shapes. The requirement is recognition of a circle, rectangle, square, and triangle. Two students were able to state their address, eight students were able to state their phone number, eight students were able to state their birth date, none of the students were able to say the days of the week, eight students were able to recognize all four basic shapes, 19 students were able to count 10 objects, and one student was able to rote count to 50. This seems to demonstrate that there is a focus in the home on counting

objects, rote counting, and identifying shapes. On the other hand, many students were unaware of what an address meant or that there were days in a week.

Figure 2

Preliminary Participation/24 Students

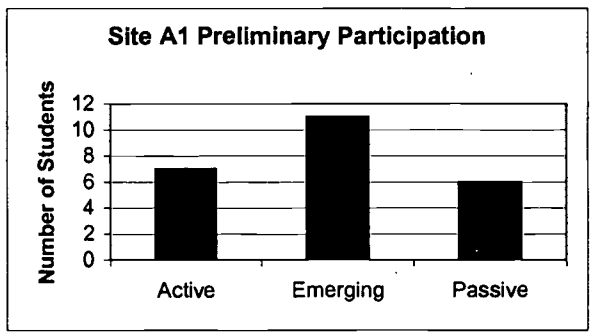


Figure 3

Preliminary Participation/21 Students

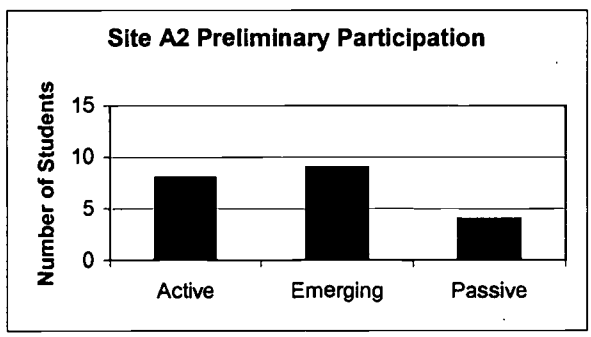
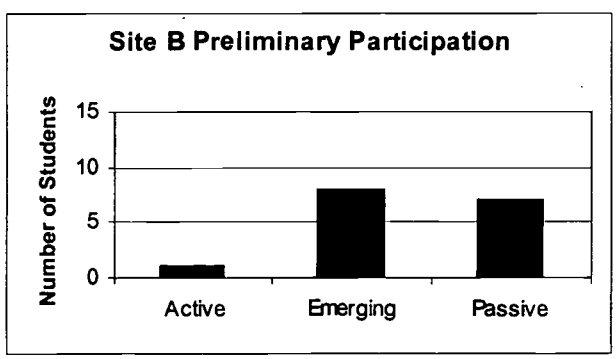


Figure 4

Preliminary Participation/16 Students



These graphs highlight students' mathematical participation prior to intervention. The graph is based on subjective teacher observations. Active participation assumes that the students are always actively engaged and participating in class. They often demonstrate the use of higher order thinking skills. Emerging participation assumes that the students are often engaged and participating in class. The mathematical processing skills of these students fall into the basic skills level with little or no application or transfer. Passive participation assumes that the students are rarely engaged during mathematical instruction. In Figure 1, the Site A1 classroom illustrates that seven students are active, 11 students are emerging, and six students are passive in regards to participation. In Figure 2, the Site A2 classroom illustrates that eight students are active, nine students are emerging, and four students are passive in regards to participation. In Figure 3, the Site B classroom illustrates that two students are active, eight students are emerging, and six students are passive in regards to participation. There is no participation data for Site C due to the fact that participation at this level is not an individual choice but a whole group requirement.

The following three tables are results of parental views of their child's mathematical attitudes. The third, fourth, and fifth grade parent surveys were mailed home during the first week of school and returned by September 7, 2001.

Table 4

Site A1 Preliminary Parent Mathematics Attitude Survey/24 Parents

Statement	Always Pre	Sometimes Pre	Never Pre	Information Unavailable Pre
My child likes math.	11	11	1	1
My child complains of feeling ill during math work.	2	6	14	2
My child enjoys hard problems.	4	13	6	1
My child does not want help during math.	3	15	5	1
My child looks forward to math class.	11	10	2	1
My child loves doing math homework.	10	12	1	1
My child likes going to the board during math.	9	10	2	3
My child thinks math is fun.	10	11	1	2
My child finds math difficult.	1	16	6	1

Table 5

Site A2 Preliminary Parent Mathematics Attitude Survey/21 Parents

Statement	Always Pre	Sometimes Pre	Never Pre	Information Unavailable Pre
My child likes math.	6	10	2	3
My child complains of feeling ill during math work.	0	5	13	3
My child enjoys hard problems.	5	8	5	3
My child does not want help during math.	5	7	6	3
My child looks forward to math class.	9	6	3	3
My child loves doing math homework.	7	7	4	3
My child likes going to the board during math.	6	8	4	3
My child thinks math is fun.	8	7	3	3
My child finds math difficult.	4	9	5	3

Table 6

Site B Preliminary Parent Mathematics Attitude Survey/16 Parents

Statement	Always Pre	Sometimes Pre	Never Pre	Information Unavailable Pre
My child likes math.	8	7	1	0
My child complains of feeling ill during math work.	1	2	13	0
My child enjoys hard problems.	2	9	5	0
My child does not want help during math.	2	13	1	0
My child looks forward to math class.	7	8	1	0
My child loves doing math homework.	4	9	3	0
My child likes going to the board during math.	7	8	1	0
My child thinks math is fun.	8	7	1	0
My child finds math difficult.	1	12	3	0

There is no parent mathematics attitude survey for Site C. This is due to the fact that these students have not had prior mathematics instruction.

The students were administered a survey to assess their attitude toward mathematics. Results from Site A1, Site A2, and Site B show, that on an average, students felt some discomfort and anxiety in the area of mathematics. There was no

survey to assess Site C's attitude toward mathematics. This is again due to the fact that these students have not had prior mathematics instruction.

We administered a parent and student multiple intelligences survey for the purpose of determining perceptions of how students learn best. These surveys were utilized to help gear instruction to students' specific learning strengths and to bolster students' comfort level with all intelligences. Results from Site A1 show that the majority of the parents and students felt that the students showed an interest in nearly all of the multiple intelligences. Results from Site A2 and Site B show that the parents felt that the students showed an interest in nearly all of the multiple intelligences. However, this was not the case with the students. Half of the students' survey results illustrated there was a strong interest in nearly all of the intelligences while the other half had mixed interests in the various intelligences. Results from Site C show that all of the students had a high interest in nearly all areas of the multiple intelligences.

Probable Causes

Low motivation and achievement in mathematics is a growing concern. Using a strict regime of drill and practice is not enough. Too often students fail to see the importance of reading, writing, and mathematics. Students will search extensively to find any meaning in rote drill and practice. Teachers are too often the disseminators of skills and information and not the developers of the curriculum and assessments (Hoerr, 1997, p. 44). Students do not see the purpose of rote drill in school or at home. They are not presented with challenges, projects, and opportunities to productively transfer the basic skills into everyday problem solving. "Hence three literacies sit like religious icons on the shelf of a tourist shop, reasonably decorative, perhaps, but out of place" (Gardner,

1991, p. 187). Researchers have documented that school children have difficulty acquiring a deep understanding of content areas. Students are presented with oversimplified views of learning. This dilution of the curriculum hinders the development of thinking processes and reflections (Gardner, 1991, p. 251). There is a warning from the National Research Council (NRC, 1989) that the mathematical skills of American students are insufficient for the problem solving that is necessary in the work place. The 1992 results of the National Assessment of Educational Progress (NAEP) showed only fifty-nine percent of twelfth grade students have the ability to solve problems more complex than whole number computation (Bottge, 1999, p. 1). Parents are concerned that their children do not comprehend mathematics even while obtaining above average grades. They desire to see their children demonstrate number sense and critically problem solve everyday experiences. Rather, parents sense that their children are simply going through the motions of daily drill and practice lessons (Wahl, 1999, p. 1).

According to the National Council of Teachers of Mathematics, there is an overemphasis on rote memory of specific rules and algorithms thus minimizing understanding and leaning towards memorization overload. Many students are hesitant to question why a particular strategy or formula works. Since many teachers were taught in this same manner, they are unable to implement Socratic dialogue in their mathematics instruction (Cornell, 1999, pgs. 225-226). Drill and practice lead to a variety of facts and skill knowledge that are not necessarily meaningful to the students. Students are too often asked to reiterate facts presented by the teacher without understanding the true meaning behind those facts (Tomlinson, 1999, p. 22). The lecture and drill approach

produces passive learners as opposed to active learners (Reynolds, 1999, p. 277). Though many students are comfortable in the passive role, they are unable to reach their true potential. Teachers are teaching one way to solve a problem. They are not teaching students how to visualize the process and therefore apply it to other situations. One teacher stated, "I was stunned to find out that not everyone worked math problems the same way" (Kelly, 1999, p. 48). There are not enough trade books being published to encourage students in their mathematical encounters (Murphy, 1999, p. 122).

Traditional approaches to instruction do not allow every student the opportunity to reach his or her true potential. In order for students to realize their potential, we must use multiple intelligences as a powerful tool (Hoerr, 1997, p. 44). Gardner poses the argument that civilization today has approached curriculum with a limited intellectual growth for students. No provision is made to educate to the multiple intelligences, thus causing a lack of motivation and achievement (Gardner as cited by Weber, 1992, p. 2). There is unequal funding and time constraints that leave the majority of students unserved by special programs, state mandates, state funds, and enrichment programs. "The lack of support for differentiated instruction for average students is one of the glaring inequities in educational practices in the United States" (Wilson, 1998, p. 8). Even dynamic teaching methods and curriculum will not reach all students equally. Educators hold false assumptions that they are reaching their students without realizing that true understanding means different things to different learners. Educators are not willing to take the time and effort to present lessons appealing to the students' multiple intelligences (Emig, 1997, p. 47). Teachers need to realize that not all students have an inherent interest in mathematics. Students are not given the opportunity to enter the

classroom through the "windows". They are not allowed to explore all the windows of mathematical possibilities (Brandt, 1993, p. 1). Teachers need to become educated and comfortable to move out of the designated curriculum and guide to engage all students in the learning of mathematics (Lesser, 2000, p. 372). Some teachers may find it difficult to move out of their comfort zone and teach to the multiple intelligences in their classrooms. Teachers who are not willing to take this step will extinguish the spark of interest in the learner. Students are not given the opportunity to use their knowledge about how they learn best (Sweet, 1998, p. 50).

Students have difficulty deciphering the connection between words and symbols in mathematics. Students make the mistake of looking past the words and going directly to the data. This leads to solutions that are incorrect upon reading the context of the problem. Students rely on superficial clues that lead to solutions that do not make sense with the language of the problem. Comprehension difficulties arise because the mathematical language is different from the students' everyday language (Roti, Trahey, Zerafa, 2000, p. 1). Students cannot assimilate the mathematical meaning of words with their everyday word knowledge. Multiple meaning words confuse students (Lansdell, 1999, p. 328). Often students are faced with a mathematical problem that does not make sense but readily begin to solve it anyway. This is due to the fact that mathematics in general does not make sense to them (Price, 1996, p. 603). It is not unusual to watch students attack a problem for several minutes not realizing their plan of attack is way off base. These students will rarely ask for help. They assume they are on the right track. There is irony in the fact that students are comfortable with this confusion.

Before the 1980's there was no interest in writing in the mathematics curriculum (Pugalee, 1997, p. 1). If students do not have the ability to write about mathematical processes, it is difficult to determine whether or not the learners understand and have the ability to transfer their knowledge. Without writing, many students are unable to prove how and why they arrived at their deduction.

Poor curricular focus and teaching deficiencies has been apparent in American students for decades (Stedman, 1997, p. 4-15). Hence, this action research project will attempt to address some of these deficiencies.

CHAPTER 3

THE SOLUTION STRATEGY

Literature Review

There are no easy solutions to increasing student motivation and achievement in mathematics. However, research suggests that teaching to the multiple intelligences is very beneficial for educating the whole learner. Literature suggests that instruction needs to be real life, personalized, engaging, interdisciplinary, and multiple intelligences based. Teachers need to stay in tune with students' passions to foster motivation and achievement in mathematics.

Mathematics needs to come out of the textbook and into real life. The National Council of Teachers of Mathematics stresses the importance of connecting to relationships and developing problem solving strategies for real life situations (Cornell, 1999). Teachers need to make connections for real life situations in order to provide students with purpose and meaning to bridge between the classroom and the world (Price, 1996). Teaching the concept of money is one way to bring the classroom into the real world. Students are able to experience what it is like to be a consumer by preparing a supermarket list, shopping for the ingredients, preparing and selling the product. "But most important, we were confident that the children developed a foundation in making sense out of cents" (Wertheimer, 1998, p. 57). Taking students out into parking lots and

playgrounds is a great way to apply mathematics. Students can determine ratios for available parking spaces, figure population densities of playgrounds, compare building size to population, and categorize vehicle attributes. Many geometry skills can be utilized through playground games such as hopscotch and four-square (Lewis, 1998). In order for students to enhance their learning, they need to see the relevance of mathematics in their lives outside the classroom. In order to evaluate all the parameters of any given situation, students need to be good problem solvers in mathematics. Students who possess good problem solving skills in mathematics will approach real life decisions in a more logical manner (Petti, 2000). Students need to reach the level of application in all areas of mathematics as illustrated by Bellanca and Fogarty's Three-Story Intellect (Bellanca, Fogarty, 1991, p.208). On the first story, the students gather information by counting, reciting, and matching. The second story requires processing of information by comparing, explaining, and inferring. The third story applies knowledge by speculating, imagining, and evaluating. Teachers need to ensure that all students work through the foundation and beams to reach the skylight of the third story intellect. Reaching the skylight is essential if students are to live in our time, to be able to understand their world to the best of their abilities, and to build upon their universe (Gardner, 1991, p.11).

Teachers need to create more personalized instruction by staying in tune with students' passions. By listening to students during discussions, teachers can become aware of the students' interests. Once the teacher knows these interests, the teacher can gear the mathematics instruction accordingly. Student motivation and achievement will increase when teachers determine what makes students tick (Wehrmann, 2000).

Education ought to be so sculpted that it remains responsive to different learning styles. We need to stop ignoring these individual differences. It is easy to pretend that all students have or ought to have the same kinds of minds. It is an educator's job; instead, to ensure that every student receives an education that maximizes his or her own intellectual potential (Gardner, 1993, p. 71). School based activities need to be integrated with sensitivity, thus minimizing the effect of crippled subsequent learning (Gardner, 1991, p. 214).

The traditional approach for learning in mathematics creates passive students. In order for students to take an active role in mathematics, it is important to engage the learner (Reynolds, 1999). Examples of engaged learning include the following: active and meaningful discussions, cooperative learning activities, hands on experiences, opportunities for exploration and discovery, and teaching to the multiple intelligences. Children need guidance to make careful observations, ask good questions, and carry out relevant experimentation. However, only after their interest has been aroused should formal instruction be introduced (Gardner, 1991, p. 193).

Using interdisciplinary thematic units can increase student motivation and achievement in mathematics. Literature suggests that there are several ways to implement this. Students will begin to communicate and reason mathematically when writing is integrated into the curriculum (Pugalee, 1997). Costumes and drama can aid in the teaching of mathematics. Students or teachers can role play various mathematicians and highlight their different theories (Shirley, 2000). Students can act out different story problems. Allowing students to illustrate and visualize word problems can increase their understanding of the problem solving process (Kelly, 1999). Through the use of

children's picture and storybooks, teachers can introduce, enrich, and reinforce mathematical concepts. Students use these books as visual cues (Jenner, 2000). Interdisciplinary instruction enables students to make connections and internalize mathematics. "We need to give kids a chance in school to enter the room by different windows, so to speak-but to be able to see the relationships among the different types of windows" (Brandt, 1993).

"Allowing students to use their knowledge about how they learn best can increase their enthusiasm, raise their achievement levels, and foster growth in their other intelligences" (Sweet, 1998, p. 50). Presentations through various modalities afford students with numerous opportunities to learn through their strengths. Daily activities should be planned around all the intelligence areas (Campbell, 1993). It is important for students to recognize the crucial difference between these two questions. The question is not, as Gardner states, "How smart am I?" rather "How am I smart?" (Gardner as cited by Emig, 1997, p. 47). Students need to realize that there are different kinds of smart. Teaching to the intelligences will keep students on task and tuned into learning. These fresh approaches are necessary to motivate students who would otherwise drift off during mathematics instruction. Teaching through the multiple intelligences helps mathematics hit home for many students. The logical/mathematical intelligence is not a strength in many students. Teaching mathematics to the other intelligences will strengthen their logical/mathematical intelligence (Wahl, 1999).

Research provides many ideas on how to implement multiple intelligence strategies. Music is a venue through which mathematics can be effectively taught. Different types of music, such as popular jingles, raps, or marches, facilitate recall

through mnemonics. The following rap is an example of how music can help students learn the steps involved in multiplying and dividing fractions: "Dividin' fractions, easy as pie: Flip the second and multiply! Multiplyin' fractions—no big problem: Top times top over bottom times bottom! When addin' fractions that you see, Match the bottoms perfectly!" (Lesser, 2000, p. 374). Another example uses rhythm instruments to help students learn fractions. Six students are placed in a small circle each with a different instrument. The rest of the class gathers around the six musicians and closes their eyes. The teacher will hold up a fraction. Based on the fraction, the correct number of students will make noise with their instruments. With eyes closed, the rest of the students need to listen to the musical sounds, determine how many instruments are played, and then determine the fraction. Two or more students can also use musical instruments to produce equivalent fractions (Hoerr, 1997).

Puzzles provide a unique alternative to mathematics instruction. Puzzles aid in numbers and operation sense, help students use patterns to problem solve, and develop critical thinking skills (Martinez, 2001). For example, students can use tangrams, geoboards, and geometric pattern blocks to enrich the learning process. Tangrams are seven geometric shapes that can be arranged to form various pictures. It takes good problem solving skills to fit all seven pieces into the fixed picture. Taking the skill to a higher level, students can manipulate the pieces to construct their own pictures. Geoboards are another kind of puzzle that students can use to construct various shapes and become familiar with geometric terms. Geoboards can also be used to teach the concepts of multiplication, division, and fractions.

Games are a fun way to teach mathematics. A deck of cards can be used to reinforce mathematical concepts. With playing cards, students can find averages, explore probability, illustrate place value, and reinforce basic facts. To help students see relationships and attributes in numbers, students can play a game. In one game, twelve cards are placed face up on a table. Players look for a common attribute among three of the twelve cards. When players find an attribute, they put the three cards in their own pile. Three new cards are placed on the table to keep the total number of cards to twelve. The game continues until all cards are dealt and no more sets are found. The player with the most sets at the end of the game wins (Quinn, 1999). Simply put, teachers should always link their instructional objectives to the eight multiple intelligences. The exceptional teacher can combine these intelligences in unique ways to create memorable learning experiences (Armstrong, 1994). "Gardner says, Teachers have to help students use their combination of intelligences to be successful in school, to help them learn whatever it is they want to learn, as well as what the teachers and society believe they have to learn" (Gardner as cited in Sweet, 1998, p. 50-51).

In order to improve student motivation and achievement in mathematics, the teachers will use Howard Gardner's eight multiple intelligences in the planning and implementation of the mathematics curriculum. The following strategies will be used to accomplish this goal. Upon completion of the action research project, the results will be analyzed to determine the effectiveness of the multiple intelligences intervention.

Project Objectives and Processes

As a result of an emphasis on teaching to the multiple intelligences, during the period of September 2001 to January 2002, the targeted kindergarten, third, fourth, and

fifth grade students are likely to improve their motivation and achievement in mathematics, as measured by beginning of the year tests, report card grades, chapter tests, participation, traveling portfolio, Illinois Standard Achievement Test (ISAT) math composite, student and parent attitude surveys, kindergarten preschool and orientation testing, and teacher anecdotal records.

In order to accomplish the project objectives, the following processes will be employed:

1. Various multiple intelligence strategies will be used to foster student motivation in mathematics.
2. A series of multiple intelligence lessons will be developed for improvement in mathematics achievement.

Kindergarten Project Action Plan

This action plan will be completed from September 2001 to mid-January 2002 in the targeted kindergarten class. The focus of intervention will be to assess student motivation and achievement in mathematics. Multiple intelligence strategies will be designed and implemented.

September 2001-October 2001

The kindergarten students will be focusing on reciting their address, phone number, and birthday. Methods employed will include centers, games, music, bodily kinesthetic activities, and mnemonic devices. The students will also learn to recognize and draw shapes through tactile, bodily/kinesthetic methods, and small cooperative groups with direct teacher instruction.

November 2001-January 2002

The goal during this time period will be counting. Students will rote count to fifty and count objects to ten. Various techniques will include centers, small cooperative groups with direct teacher instruction, music, bodily/kinesthetic activities, visual/spatial, and verbal/linguistic based activities. Students will also recite the days of the week using games, music, bodily/kinesthetic activities, and mnemonic devices.

Third, Fourth, and Fifth Grade Project Action Plan

This action plan will be completed from September 2001 to mid-January 2002 in the targeted third, fourth, and fifth grade classes. The focus of intervention will be to assess student motivation and achievement in mathematics. Multiple intelligence strategies will be designed and implemented. During the first two weeks of school, the teachers will introduce Howard Gardner's theory of multiple intelligences. The students will complete a survey to assist them in discovering their own intelligences. The teachers will teach each of the multiple intelligences and provide opportunities for the students to experience activities dealing with each intelligence. These activities will familiarize students with their multiple intelligences and begin to develop metacognition. The

following table illustrates the tentative timeline and concepts for the mathematics curriculum during the first and second grading period of the 2001-2002 school year.

Month	Third Grade	Fourth Grade	Fifth Grade
September	*Addition *Subtraction	*Place Value *Algebra Introduction *Roman Numerals	*Addition, Subtraction and Multiplication of Whole Numbers and Decimals * Fractions
October	*Place Value	* Addition and Subtraction of Whole Numbers *Graphing	* Fractions
November	*Time and Money	*Probability *Multiplication Facts	* Fractions
December	*Geometry	*Multiplication Facts *Time	*Geometry
January	*Multiplication Facts	*Time *Money	*Geometry

Lessons will be taught through the eight multiple intelligences. These lessons will include centers, cooperative learning, games, graphic organizers, journaling, and other activities encompassing Gardner's eight intelligences.

Methods of Assessment

In order to evaluate the effects of the multiple intelligence interventions, parent and student pretests and surveys will be compared with their posttests and surveys. The teachers' anecdotal records will be reviewed. Chapter tests will be administered. Report card grades will be analyzed. Student participation will be evaluated through teacher observation and anecdotal records. The traveling portfolios and Illinois State Achievement Tests will be examined prior to the action research project to determine students' past strengths and weaknesses in math.

CHAPTER 4

PROJECT RESULTS

Historical Description of the Intervention

The objective of this project was to improve student motivation and achievement in mathematics. Multiple intelligence strategies were used throughout the intervention period with the targeted kindergarten, third, fourth, and fifth grade classrooms.

The beginning phase of the action plan was completed during the first two weeks of September 2001. Students were introduced to Howard Gardner's theory of multiple intelligences and were allowed time to identify their own strengths and weaknesses within those intelligences. In preparation for our action plan, students and parents were given surveys on multiple intelligences and their attitudes towards mathematics. Preliminary data was collected from the following areas: traveling portfolios, beginning of the year tests, report card grades, participation, preschool and orientation testing, and teacher anecdotal records. This varied slightly from our original action plan due to the elimination of Illinois Standard Achievement Test (ISAT) math composite data and chapter tests. The ISAT math composite was eliminated due to the fact that post data would be unavailable. The results from chapter tests were incorporated into the report card data since there would be no available chapter test comparisons. The action plan

was completed from September 2001 to January 2002 in the targeted kindergarten, third, fourth, and fifth grade classes.

The third grade focused on addition, subtraction, place value, time and money, geometry, and multiplication. Site A1 data reflects a decrease of five students due to student mobility within the site setting.

The fourth grade focused on place value, algebra introduction, addition and subtraction of whole numbers, graphing, probability, and multiplication facts. The areas not covered were Roman numerals, time, and money due to the need for slower pacing with Site A2 student population. Site A2 data reflects a decrease of one student due to mobility out of the district.

The fifth grade focused on fractions and geometry. The areas not covered were place value, addition and subtraction of whole numbers and decimals, and multiplication and division of whole numbers and decimals. This portion of the action plan changed due to the need for a more thorough focus on fractions and geometry using multiple intelligences. The other areas were covered through a traditional approach. Site B data reflects the results of 16 out of 19 students. Although all 19 students received multiple intelligences instruction, three students were not granted permission to become part of the data reported in the action research project.

The kindergarten focused on recitation of address, phone number, birthday, days of the week, recognition of basic shapes, object counting to 10, and rote counting to 50. Site C data reflects 21 out of 25 students. Although all 25 students received multiple intelligences instruction, four students were not granted permission to become part of the data reported in the action research project.

Throughout the intervention period, the students of Site A1 learned addition, subtraction, place value, time and money, geometry, and multiplication. Multiple intelligences were used in order to increase students' motivation and achievement in mathematics. During the teaching of all subject areas, the verbal/linguistic and intrapersonal intelligences were used in the form of journaling. Students used the journals for two purposes. First, the students would reflect on the day's lesson. Students commented, "I like math because all the time we work together as a team", "I felt smart, happy, and I was having fun working my brain", and "I didn't like drawing pictures because I knew the answer, and it took a longer time with drawing." Secondly, the journal was a means to foster independent and critical thinking as well as develop problem-solving skills. Once a week the students were given a problem that they had to independently solve and explain.

The first two mathematical areas to be taught were addition and subtraction. The use of bodily/kinesthetic and interpersonal intelligences were used during this time. Students worked together to dramatize word problems, create human graphs, and used structured cooperative games for academic learning. The logical/mathematical intelligence was addressed through timed "Mad Minute" quizzes which became a daily routine. The visual/spatial intelligence was utilized when the students created line graphs of their "Mad Minute" results.

The next mathematical area to be studied was place value. Interpersonal skills were enhanced when students played a rounding board game. Visual/spatial skills were developed as students drew pictures to solve word problems. The musical/rhythmic

intelligence was fostered when classical music was played during independent work time.

Time and money became the next focus of instruction. Visual/spatial, bodily/kinesthetic, verbal/linguistic, and logical/mathematical intelligences continued to be utilized as students manipulated actual clocks and money in order to learn specific concepts. Students also learned how to solve word problems using an organized list. These activities required them to manipulate items, create lists, and share with a partner.

The next mathematical area to be studied was geometry. The naturalist intelligence was enhanced when the students took a walk outside to identify space and plane figure examples. Students utilized their visual/spatial and logical/mathematical intelligences a lot during this unit. Student created pictures out of shapes, wrote and shared creative stories, and used geo-boards to understand the concepts of polygons and angles. Symmetry, congruency, and coordinate geometry required the use of the visual/spatial intelligence. Activities to teach these concepts included drawing a symmetrical butterfly, designing congruent pictures on graph paper, and plotting the coordinates to create a specific picture.

The final mathematical area of instruction was multiplication. When the students found out that we were finally going to do multiplication, excitement was in the air. This was what third grade was all about, multiplication. Instruction began with the students drawing pictures and using their bodies to represent the multiplication problem. The use of multiplication songs and raps met the needs of those students who favored the musical/rhythmic intelligence. Verbal/linguistic, interpersonal, and intrapersonal intelligences activities included making flashcards, quizzing a partner, and mandatory

daily practice. Timed tests held the students accountable for their learning. One student passed all eleven tests the first time around. The student was so excited that she had accomplished this goal. Her enthusiasm sparked others to strive for that same goal.

Within Site A2, the teacher instructed students in mathematics hoping to increase motivation and achievement by gearing her instruction to the multiple intelligences of her students. During the period of action research, the concepts of place value, algebra, addition and subtraction of whole numbers, graphing, probability, and multiplication facts were covered.

The first concept taught was place value. The teacher addressed all the intelligences in her instruction. The verbal/linguistic intelligence was taught to the pupils through student practice in reading large numbers and writing them in words. Students used their journals to illustrate the steps they would take in rounding numbers. This appealed to those with intrapersonal strengths. The logical/mathematical intelligence was addressed through traditional pencil and paper practice as well as through comparing and ordering numbers through the game of SNAP. Often during pencil and paper practice, classical music was played to appeal to students strong in the musical intelligence. The bodily/kinesthetic intelligence was instructed through the games of SNAP and "Make This Number". In the game "Make This Number", each child was a single-digit number and had to find his correct place value within a large number read off by the teacher. These, as well as other games, appealed to those who enjoyed working with others. To involve those students who come alive with nature, the teacher had the children do some manipulative work using blades of grass as ones, pebbles as tens, sticks as hundreds, and leaves as thousands.

Next, the children received a brief introduction to algebra and the balancing of equations. During the algebra component, the intelligences implemented were verbal/linguistic, logical/mathematical, bodily/kinesthetic, interpersonal, and intrapersonal. As with every concept, the students were given time to reflect and write in their journals. The pupils used balances and cubes to form equations. They then advanced from the scale to putting in +, -, and = signs, using the equal sign as the center of the balance. This activity was done in small groups. Each group had to write down as many balancing equations as they could using the signs and numbers they were given.

Math instruction then moved to addition and subtraction of whole numbers. In this unit all the intelligences were considered in lesson design. Journaling was completed about the processes of carrying and borrowing. The students even drew in journals to illustrate these processes. They grappled with story problems using their visual/spatial intelligence to draw them. Students practiced lining columns up in straight lines to avoid making careless errors. Place value blocks were used to depict the concepts of carrying and borrowing. In a similar manner, natural materials were used. Touch math was reviewed as an aid for those who were not proficient with their facts. Games of "Ninety-Nine" and "Twist 'Em", as well as games played at the board in teams, were used as vehicles for practice. Again, classical music was played often times during paper and pencil drill. Review before the final assessment was done with a pairs share activity.

With the graphing unit, all the intelligences were addressed in instruction. Students were given graphs and needed to interpret those graphs in their journals. Everyday they practiced graph reading of current graphs from USA Today. They collected and classified leaves according to characteristics and generated a leaf graph.

They analyzed graphical relationships in a family tree. They made pictographs for a project with M & Ms and graphed coordinates to reveal pictures. Using their bodies, they made human bar graphs and pie graphs. The class made and flew paper airplanes and measured their flight distances. They created line graphs to illustrate their flights and determined their planes' effectiveness. They graphed the results of various class surveys on the computer. They surveyed members of the class in order to complete a project called "My Favorite Things".

After graphing, the students completed a short study of probability. Verbal/linguistic and intrapersonal intelligences were utilized through journaling about how you can use probability to help you make predictions. A discussion ensued about the fairness in kickball. Cooperatively, the students made a plan to increase the fairness of kickball games. Bodily/kinesthetic and interpersonal intelligences were targeted through dice games and group experimentation with the probability of picking certain colored cubes out of a bag.

The final concept studied during the period of action research was multiplication facts. All the intelligences were targeted in centers as well as in activities. There was a center where there was a story for each multiplication table. The students created story problems for each fact. Other centers included such things as self-practice, flash cards, memory games, draw the facts, multiplication rap, representation of facts as illustrated with objects from nature, and computer practice. The students also journaled about the process of multiplication. They solved patterns and story problems. They drew pictures representing facts and worked with fact family triangles. To learn their two's, they worked with mirrored images. They brainstormed and listed things that normally come

in twos, threes, fours, and so on. They made 12-sided figures when studying their twelve's. They created books for each table as they learned it. The class played countless games to practice the facts including "Around the World", "Cover It", "Rectangles", and "Multiplication Ball" to mention a few. They sang and danced around the room to "I Got Plenty O' Nuttin'" to learn the zero property. The students learned and practiced a method of finger counting to help them with their nine's facts. By using cubes and nature objects, students learned about the multiplication process. Children practiced facts in sand and shaving cream. They learned songs for each table and watched and sang along with Multiplication Rock. Working in partners, small groups, and whole group, students practiced and drilled the facts. The students shared multiplication memory tricks with each other.

Throughout the action research, the students enjoyed the bodily/kinesthetic activities the most. They also enjoyed all the activities that had to do with nature or that took place outside. However, the researcher believes that the presentation of material in a variety of ways is what brought the children to real understanding.

The intervention of Site B was implemented by focusing on two particular units of study in mathematics. The two units were fractions and geometry. The development of these units centered around Howard Gardner's theory of multiple intelligences.

The fraction component of the action research plan was completed during the first quarter and part of the second quarter of the school year. This unit focused on skills introduced to the students using instructional approaches based on Gardner's eight multiple intelligences. Gardner's eight multiple intelligences were addressed through activities such as journaling, mathematical card games, cooperative learning, drawing,

composing songs, poems and raps, reading picture books, composing fraction riddles, fraction centers, cooking with fractions, and recognizing fractional values on sheet music. Lesson samples for this unit are provided in Appendices C.

In order to assess the effectiveness of the intervention on student motivation in mathematics, student participation was observed and noted. In addition, student responses were read and noted in their fraction journals after lessons. Research results regarding student motivation are provided in Figure 8. In order to assess the effectiveness of the intervention on student achievement in mathematics, grade reports were analyzed and noted, as well as, pre and post grade level tests. Student achievement results are provided in Table 9.

The geometry component of the action plan was completed during the second quarter of the school year. Again, this unit focused on skills introduced to the students using instructional approaches based on Gardner's eight multiple intelligences. Gardner's eight multiple intelligences were implemented through strategies such as journaling, drawing and other art activities, creating lines, segments, rays, points, and angles with their bodies, geometry centers, cooperative learning, exploring with pattern blocks, reading picture books, geometry scavenger hunts, geo-board activities, and technology projects in the computer lab. Lesson samples for this unit are provided in Appendices C.

Again, in order to assess the effectiveness of the intervention on student motivation in mathematics, student participation was observed and noted. In addition, student responses were read and noted in their geo-logs after lessons. Research results regarding student motivation are provided in Figure 8. In order to assess the

effectiveness of the intervention on student achievement in mathematics, grade reports were analyzed and noted, as well as, pre and post grade level tests. Student achievement results are provided in Table 9.

Students' reactions to instructional strategies were key throughout the intervention. After each lesson, students were given time to reflect and write in their journals or logs about what they liked, what they did not like, and what they learned from the lesson. In addition, whole group discussions were held at the close of the lessons to gain insight into students' reactions to each lesson. After completing the geometry centers, one student commented, "I like to work with centers because you get to have fun and learn at the same time. It was fun to make different angles with our bodies!" Another student stated, "I could pay attention easier." During the composition of their fraction raps, a student noted, "I love to make raps because I get to be creative. I'm a good writer." Student participation was also observed and noted to determine the level of motivation and interest in the mathematics lesson.

The kindergarten classroom of Site C lent itself easily to teaching through the multiple intelligences. The students of Site C were already accustomed to learning through every method except paper and pencil tasks. The researcher found most of the students ready and willing to try any novel approach to learning put before them. The more the students were involved with their hands and bodies, the better they liked it.

Shapes were targeted many different ways. Utilizing the visual/spatial intelligence, we drew pictures using only the four basic shapes, put together a shape flatbed truck, and used the computer to draw and stretch the shapes. The researcher also tried to have the students visualize a rectangle as a square whose sides were all wrecked

and not perfect like a square. To incorporate the bodily/kinesthetic intelligence, the students used partners to form the shapes with their bodies. The students also drew the shapes in shaving cream and sand with their fingers. The students enjoyed all the activities. The computer stretch and draw was difficult for some of the students. When the students visualized a rectangle as a square that was wrecked, there were two reactions. While this cleared up the confusion for some, it tended to make others more confused.

Four of the multiple intelligences were used to target rote counting to 50. The verbal/linguistic and intrapersonal intelligences were stressed during journal writing. The focus of the journal writing was stories about numbers. Students also practiced writing the numbers. Various musical counting tapes revolved around the musical/rhythmic intelligence. The bodily/kinesthetic intelligence was highlighted with counting and changing body movements for every set of 10. The students enjoyed the music and movement emphasis more than the fine motor projects for counting. Writing is tedious at this young age, and many of the students were not comfortable with the inventive spelling used in kindergarten.

The musical/rhythmic intelligence was the basis for much of the memorization of the days of the week. Different song themes, clapping patterns, and animal sounds helped facilitate learning. The verbal/linguistic intelligence was used by spelling the words on dry erase boards and putting together a days of the week storybook. The songs were the favorite part of learning this skill for the students.

The naturalist intelligence was utilized during instruction on counting objects to 10. Students went outside, collected leaves and rocks, and grouped them into groups of

10 on the playground. The whole topic of counting objects to 10 lent itself to the logical/mathematical intelligence. This was extended by patterning groups of 10 and utilizing attribute blocks. The students also calculated groups of 10 on the computer and completed number puzzle matches. The bodily/kinesthetic intelligence was targeted when the students made human chains and needed to determine the number of bodies necessary to complete chains of 10. The favorite activities of the students were the outdoor collecting and counting, as well as the human chains.

The necessary memorization of address, phone number, and birthday was difficult to integrate through the multiple intelligences. This stemmed from the fact that each student had to memorize something different. The bodily/kinesthetic intelligence was utilized by constructing body graphs of common streets, first three digits of their phone numbers, and common birthday months. The students also used the logical/mathematical intelligence by putting together puzzles of their phone numbers. Parents were an integral part of this goal. Much of the memorization of these skills was completed at home.

Presentation and Analysis of Results

The following tables and figures represent the pre and post intervention data. An analysis of each table and figure are provided below.

Table 7

Site A1 Post Data Collection/19 Students

Grading Scale	Traveling Portfolio		Grade Level Test		Report Card Average	
	Pre	Post	Pre	Post	Pre	Post
A	3	9	0	2	0	2
B	5	5	1	3	14	8
C	3	3	3	6	4	6
D	2	1	4	1	0	3
F	3	1	15	7	0	0
Information Unavailable	8	5	1	5	6	5

The traveling portfolio reflects an increase of six students receiving an A. Students receiving a B or C remained consistent. There was a decrease of one student receiving a D and a decrease of two students receiving an F. The grade level test results reflect an increase of two students receiving an A or B. There was an increase of three students in the C range. There was a decrease of three students in the D range and eight students in the F range. The report card averages reflect an increase of two students receiving an A or C. There was a decrease of six students receiving a B. There was an increase of three students in the D range. The intervention appeared to have had a positive impact on student learning in mathematics. There is uncertainty at the lower end of the grading scale due to the relocation of five students during the intervention period.

Table 8

Site A2 Post Data Collection/20 Students

Grading Scale	Traveling Portfolio		3rd Grade Level Test		Report Card Average	
	Pre	Post	Pre	Post	Pre	Post
A	1		1	1	5	5
B	2		4	9	5	6
C	3		7	3	4	4
D	2		1	0	3	5
F	9		8	7	1	0
Information Unavailable	4		0	1	3	1

Due to an incoming student teacher in January 2002 and time constraints, there is no post traveling portfolio data. Low student achievement made it necessary to administer a third grade pre and post-test. Students receiving an A remained constant at one. There was an increase of five students in the B range. There was a decrease of four students receiving a C. There was a decrease of one student receiving a D or an F. The report card averages remained consistent in the A and C range. There was an increase of one student receiving a B. There was an increase of two students in the D range. There was a decrease of one student in the F range. While the intervention appeared to have demonstrated varied results, it can be noted that the average students scored higher on the post third grade test.

Table 9

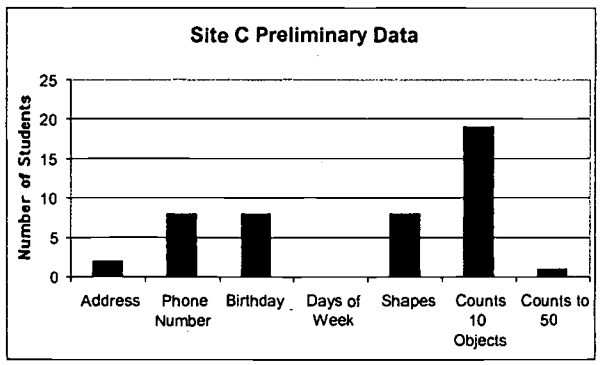
Site B Post Data Collection/16 Students

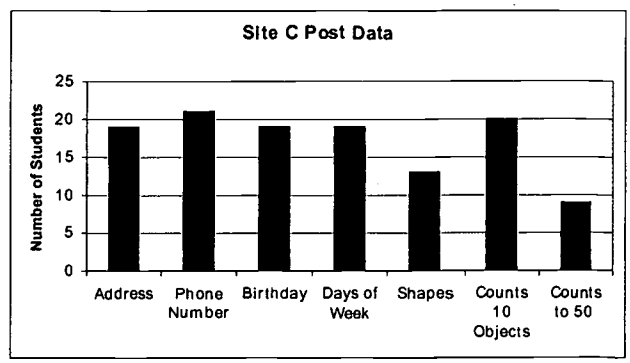
Grading Scale	Grade Level Test		Report Card Average	
	Pre	Post	Pre	Post
A	0	14	3	4
B	1	1	9	11
C	4	1	4	1
D	4	0	0	0
F	7	0	0	0
Information Unavailable	0	0	0	0

There was an increase of 14 students receiving an A on the grade level test. The students receiving a B remained constant at one. There was a decrease of three students receiving a C. There was a decrease of four students receiving a D and seven students receiving an F. There was an increase of one student in the A range on the report card. There was an increase of two students receiving a B. There was a decrease of three students in the C range. Overall, the results showed a significant increase in student achievement, specifically on the grade level test.

Figure 5

Site C Post Data Collection/21 Students

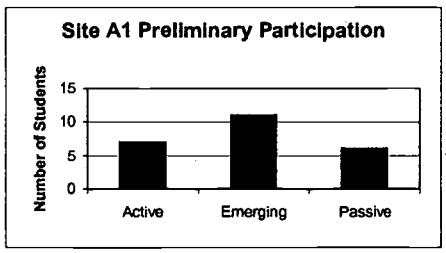




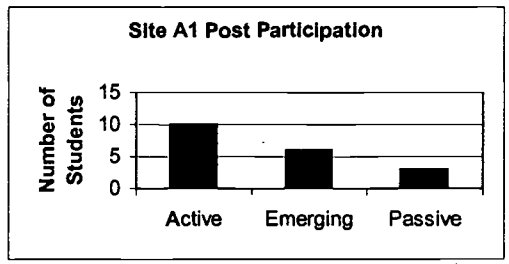
There was an increase of 17 students in address recitation. There was an increase of 13 students reciting their phone number. There was an increase of 11 students knowing their birth date. There was an increase of 19 students able to recite the days of the week. There was an increase of 15 students in shape recognition. There was an increase of one student who could count 10 objects. There was an increase of eight students with the ability to rote count to 50. There was a significant increase in all areas of mathematical achievement. The highest increase occurred in reciting the days of the week. Student knowledge in this area was non-existent prior to intervention.

Figure 6

Preliminary Participation/24 Students



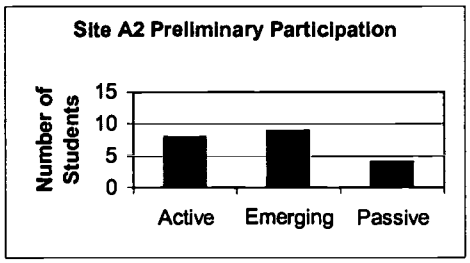
Post Participation/19 Students



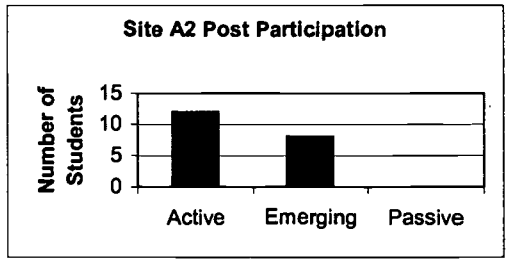
There was an increase of three students who had active participation in class. There was a decrease of five students who showed emergent participation. There was a decrease of three students in passive participation. The above graphs indicate a loss of five students due to mobility.

Figure 7

Preliminary Participation/21 Students



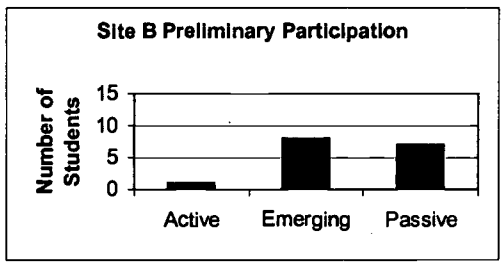
Post Participation/20 Students



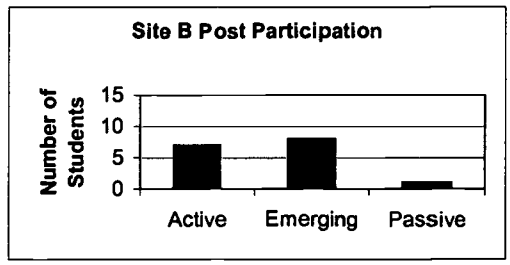
There was an increase of four students who had active participation in class. There was a decrease of one student who showed emergent participation. There was a decrease of four students in passive participation. The above graphs indicate the loss of one student due to mobility.

Figure 8

Preliminary Participation/16 Students



Post Participation/16 Students



There was an increase of six students who had active participation in class. There was no change in students who showed emergent participation. There was a decrease of six students in passive participation.

Table 10

Site A1 Post Parent Mathematics Attitude Survey/19 Parents

Statement	Always		Sometimes		Never		Information Unavailable	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
My child likes math.	11	8	11	11	1	0	1	5
My child complains of feeling ill during math work.	2	0	6	4	14	15	1	5
My child enjoys hard problems.	4	3	13	10	6	6	1	5
My child does not want help during math.	3	4	15	13	5	2	1	5
My child looks forward to math class.	11	9	10	10	2	0	1	5
My child loves doing math homework.	10	5	12	12	1	2	1	5
My child likes going to the board during math.	9	14	10	2	2	2	3	6
My child thinks math is fun.	10	10	11	8	1	1	2	5
My child finds math difficult.	1	2	16	14	6	3	1	5

The post parent mathematics attitude survey shows a strong trend in two areas. There was a decrease of five in the number of parents who felt that their child loved doing mathematics homework. Conversely, there was an increase of five in the number of parents who felt their child liked going to the board during mathematics. This may

conclude that students feel more comfortable doing mathematics in the classroom setting as opposed to at home.

Table 11

Site A2 Post Parent Mathematics Attitude Survey/20 Parents

Statement	Always		Sometimes		Never		Information Unavailable	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
My child likes math.	6	8	10	11	2	1	3	0
My child complains of feeling ill during math work.	0	0	5	3	13	17	3	0
My child enjoys hard problems.	5	6	8	7	5	5	3	0
My child does not want help during math.	5	5	7	7	6	6	3	0
My child looks forward to math class.	9	12	6	6	3	2	3	0
My child loves doing math homework.	7	9	7	8	4	3	3	0
My child likes going to the board during math.	6	12	8	8	4	0	3	0
My child thinks math is fun.	8	12	7	7	3	1	3	0
My child finds math difficult.	4	5	9	11	5	4	3	0

The post parent mathematics attitude survey shows a strong trend in one area. There was an increase of six in the number of parents who felt their child liked going to the board during mathematics. There was an increase in four parents who felt that math was fun for their child. There was a decrease of four parents whose children complained

of ill symptoms during mathematics. Overall, the trends seem to show an increase in comfort level during mathematics.

Table 12

Site B Post Parent Mathematics Attitude Survey/16 Parents

Statement	Always		Sometimes		Never		Information Unavailable	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
My child likes math.	8	8	7	8	1	0	0	0
My child complains of feeling ill during math work.	1	0	2	1	13	15	0	0
My child enjoys hard problems.	2	7	9	7	5	2	0	0
My child does not want help during math.	2	4	13	11	1	1	0	0
My child looks forward to math class.	7	10	8	5	1	1	0	0
My child loves doing math homework.	4	8	9	8	3	0	0	0
My child likes going to the board during math.	7	14	8	2	1	0	0	0
My child thinks math is fun.	8	12	7	4	1	0	0	0
My child finds math difficult.	1	0	12	13	3	3	0	0

The post parent mathematics attitude survey shows a strong trend in two areas. There was an increase of five in the number of parents who felt their child liked solving hard problems. There was an increase in seven parents who felt their child liked doing mathematics problems at the board.

There was no survey to assess Site C's attitude toward mathematics. This is again due to the fact that these students have not had prior mathematics instruction.

Conclusions and Recommendations

Based on the presentation and analysis of the data presented, the intervention of multiple intelligences in the area of mathematics showed some improvements in student motivation and achievement.

Third grade students of Site A1 showed improvement on the traveling portfolio second grade test. The number of students increased greatly in the A range. The reason for this may have been due to the review of content material through the use of multiple intelligences. A marked improvement is seen with the third grade level pre and post tests. The combination of learning new content material and the use of multiple intelligences may be the reason for the results reported. The primary and intermediate report card grading scales differ, possibly accounting for the increase in lower achievement grades. In regards to student motivation, there was an increase in active participation. There was a decrease in emerging and passive participation. The mobility of five students may account for the decrease at the emerging level.

Fourth grade students of Site A2 showed improvement on the third grade level pre and post tests. Although it appears that the students at the F range remained constant, an analysis of their individual test results show that these students did actually gain in percentage points. The report card averages remained primarily consistent with the previous year's grade reports. In regards to student motivation, the students either stayed the same or became more actively involved during mathematics class.

Fifth grade students in Site B showed a dramatic improvement on grade level pre and post tests. The combination of learning new content material and the use of multiple intelligences may be the reason for the results reported. The report card averages showed slightly higher results than the previous year's grade report. The reason for this increase may be the use of multiple intelligences instruction and the fact that the students of Site B entered fifth grade well prepared to meet the challenges of the new content. In regards to student motivation, the students who were passive moved to the emerging category while those in the emerging category moved to the active category.

Kindergarten students in Site C exhibited remarkable growth. This needs to be prefaced by the fact that many kindergarten students come to school with little or no previous knowledge or experience. Many of the areas targeted during intervention were completely unfamiliar. The one exception was counting 10 objects. There was only a slight increase in this category due to a high rate of success during baseline testing. The smallest amount of increase was seen in the category of rote counting to 50. The reason for this may be that these students are not developmentally prepared for a memorization of this magnitude. The transition to the tens while counting to 50 needed a great deal of teacher prompting. There was a slight increase in the number of students who could name all four shapes. However, many of the students recalled more shapes than they did on the baseline testing. The confusion for the students was in discriminating between a square and a rectangle. The largest margin of growth was in recitation of the days of the week. This skill was non-existent during baseline testing. During individual post testing, many of the students needed to sing in order to recite the days of the week. Very few students were able to state the days without singing. This would draw a conclusion that

the musical/rhythmic intelligence contributed to the success of the students on this skill. It needs to be restated that memorization in the areas of address, phone number, and birthday were primarily successful due to parental intervention. Although multiple intelligences strategies were implemented, in class success was hindered by the fact that each student needed to learn something different.

Overall, the implementation of our action plan had positive results for teachers and students. It was an enjoyable experience in the eyes of both. There was an increase in motivation, positive attitudes, and comfort level for students in mathematics. We feel this illustrates a direct correlation between implementing multiple intelligences and students' attitudes towards mathematics. By using multiple intelligences based instruction, we provided a variety of lessons designs to accommodate differentiated learning styles. We felt we grew professionally as we were forced to step out of our traditional mode of teaching.

One needs to exercise caution before attributing multiple intelligences based instruction to academic achievement during the intervention period. We determined that other variables could have played a role in the positive results in the area of student growth and achievement. We did not feel that there were any extraneous variables accounting for the increase in student motivation.

In retrospect, there are several aspects of the action plan that need further consideration or revision. Surveys are one aspect to be examined. The parent survey was ineffective due to the fact that the students themselves may have answered many of the surveys. The parents did not have enough background to complete the surveys. A suggestion might be to allow students time to become familiar with using the surveys

prior to the implementation of the action plan in order to provide more meaningful results.

Another aspect to consider would be the addition of a checklist to make observations such as frequency of participation, time on task, and cooperation skills. This would take some of the researchers' subjectivity out of the results for student participation. These three skills are a major part of school achievement and success, and researcher analysis may depict important trends in data.

The final aspect to consider would be to include a traditional approach to instruction as well as the use of multiple intelligences based instruction. This would enable the researcher to distinguish the effectiveness of the multiple intelligences based instruction in comparison to a traditional approach. This would clear up some of the uncertainty surrounding the question of extraneous variables influencing the student achievement results. This would also assist the students who require additional drill and practice.

In closing, the most beneficial aspect of our research is that it takes into consideration human differences within the classroom and teaches subject matter in a variety of ways appealing to all learners. As the traditional Chinese saying goes, " 'Let a hundred flowers bloom' is a wonderful theme for the use of multiple intelligences theory in the classroom. Begin slowly, find what works for you and your students, and then stand back and breathe in the fragrance of your beautiful, blooming flowers."

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Appendices

Appendix A
Third Grade Multiple Intelligences Mathematics Lesson Plans

Content Area:
- Addition

Grade Level:
- Third

Targeted Intelligences:
- Interpersonal
- Logical/Mathematical

Lesson Objective:
- The students will practice adding three numbers.

Materials:
- Paper
- Pencil
- Three dice for each pair of students

Activity:
- Students will play the game "One-Two-Three".
- Students will find a partner.
- Students will determine who goes first by rolling the dice, and the student with the higher number will begin.
- The student will roll the three dice.
- He or she will add up the numbers.
- The next student will take his or her turn.
- The higher of the two sums will score a point. If it is a tie, no one will score.
- Play continues until one student reaches ten points.

Homework Assignment:
- None

Appendix A (continued)

Content Area:
- Word problems

Grade Level:
- Third

Targeted Intelligences:
- Bodily/Kinesthetic
- Interpersonal
- Intrapersonal
- Logical/Mathematical
- Visual/Spatial

Lesson Objective:
- The students will solve word problems using an organized list.

Materials:
- Paper
- Pencil
- Chalk & chalkboard
- Four different colored smiley faces for each student

Activity:
- To introduce the lesson, have three students stand in front of the classroom.
- The class must then figure out how many different ways the three students can be arranged in left-to-right order.
- The three students will act out each arrangement.
- The teacher will systematically list all arrangements on the chalkboard.
- The students will then use their four different colored smiley faces to systematically list all the possible ways the faces can be arranged in a left-to-right order.
- The teacher will pair off the students and have each partner check his or her partner's list.

Homework Assignment:
- None

Appendix A (continued)

Content Area:
- Geometry

Grade Level:
- Third

Targeted Intelligences:
- Interpersonal
- Intrapersonal
- Logical/Mathematical
- Verbal/Linguistic
- Visual/Spatial

Lesson Objective:
- The students will take plane shapes, create a truck, write an adventure story, and share the story with the class.

Materials:
- Paper
- Pencil
- Scissors
- Glue
- Construction paper shapes: two circles, two rectangles, two squares, one triangle

Activity:
- Students will construct a construction paper truck using the provided shapes.
- Students will then write a creative story about someone riding in the truck.
- Students will share their stories with the class.

Homework Assignment:
- None

Appendix B
Fourth Grade Multiple Intelligences Mathematics Lesson Plans

Content Area:
- Graphing

Grade Level:
- Fourth

Targeted Intelligences:
- Bodily/Kinesthetic
- Interpersonal
- Logical/Mathematical
- Naturalist
- Visual/Spatial

Lesson Objective:
- Identification and classification of local leaves
- Bar graphing

Materials:
- Paper lunch bags for leaf collection
- Chart paper lined off as graph paper in 6 inch squares (one for each group of 3-4)
- Leaf identification books or sheets

Activity:
- Go outside and collect leaves
- Working as a group, sort leaves into like groups
- Identify leaves
- Using large graph paper make a bar graph using actual leaves glued onto paper, making sure to include title, labels, and number scale

Homework Assignment:
- Tally and bar graph contents of refrigerator by classifying as meat, dairy, condiments, beverages, fruit, and vegetables

Appendix B (continued)

Content Area:
- Place value

Grade Level:
- Fourth

Targeted Intelligences:
- Bodily/Kinesthetic
- Interpersonal
- Logical/Mathematical
- Visual/Spatial

Lesson Objective:
- Place value through hundred thousands
- Ordering numbers

Materials:
- Snap boards
- Playing cards (ace, one, two, three, four, five, six, seven, eight, nine)

Activity:
- Each child has a board and set of nine cards (ace stands for one)
- Student shuffles set of nine cards and places them face down on board
- Teacher calls out game determiner (highest number, lowest number, number closest to, number between _____ and _____)
- Teacher calls out "1,2,3, Snap!"
- Student turns over top card on pile and places it on Snap board using strategy (i.e.: if game is about making the highest number, student may place a nine if he drew it in the hundred thousands place)
- Student must make one discard out of the nine cards
- Teacher continues signaling turnover of card pile one by one saying, "1, 2, 3, Snap!" until all cards are turned over
- Teacher asks class who thinks he has the **highest** number (lowest number, number closest to, or any number between _____ and _____)
- All students thinking they may be the winner must read their number out loud correctly
- By listening carefully, class decides who is indeed the winner
- Winner(s) is awarded with a sticker, piece of candy, or point
- Play continues with teacher making a determiner for next round of play

Homework Assignment:
- Varied written practice writing numbers from number words, ordering numbers, and journal writing on how you order numbers

Appendix B (continued)

Discard Pile

hundred-thousands

ten-thousands

thousands

,

hundreds

Cards face down

tens

ones

SNAP!

Appendix B (continued)

Content Area:
- Graphing

Grade Level:
- Fourth

Targeted Intelligences:
- Bodily/Kinesthetic
- Interpersonal
- Logical/Mathematical
- Naturalist
- Visual/Spatial

Lesson Objective:
- Graphing with pie graphs

Materials:
- Rope
- Sidewalk chalk

Activity:
- Children go out to playground
- Using a rope with a piece of chalk tied on one end, have one child stand in wide-open spot on playground holding the end of rope without the chalk
- Another child stretches out rope to full length and proceeds to draw a circle using rope as the circle's radius
- Students then line up in separate lines according to shoe color (this represents making a pre-graph tally)
- Then have all students stand around circle group by group, equally distancing themselves
- Using string and masking tape, run strings taping ends from circle center to outside of circle between each shoe color group
- Have students stand back from circle, label each section according to shoe color, put a title on the graph, and look at their visual representation

Homework Assignment:
- Take time to do an in-class survey of favorite candy (limit to five different types of candy of class choice)
- Have students complete a tally in class showing class preferences
- In class, have children make a circle using a compass, marking the center with a dot

Appendix B (continued)

- At home, with equally sized colored paper cubes, children will spread them around the circle similarly to the day's outside activity (a separate color representing each different candy choice)
- Using a ruler, children will draw lines from outside edge of circle to center of circle in between each candy choice
- Label and title graph

Appendix C
Fifth Grade Multiple Intelligences Mathematics Lesson Plans

Content Area:
- Fractions

Grade Level:
- Fifth

Targeted Intelligences:
- Bodily/Kinesthetic Interpersonal
- Interpersonal
- Logical/Mathematical

Lesson Objective:
- Students will practice changing improper fractions to mixed numbers.

Materials:
- Deck of playing cards for each pair of students
- Stop watch or clock with second hand
- Pencils
- Paper

Activity:
- Remove all face cards (kings, queens, jacks) from deck of playing cards.
- Sort the cards into a stack of black cards and a stack of red cards based on color of suit. These two stacks will be used to construct fractions. The black cards are the numerators and the red cards are the denominators. Aces count as 1's.
- Player one shuffles the black cards and places them facedown in a pile in the center of the table. He then shuffles the red cards and places them facedown below the black cards.
- Player one turns over the top red card, which is the denominator for all the fractions in the player's turn. Player two starts the stopwatch, and player one turns over the top black card, the first numerator. If the fraction is proper, player one says, "Proper fraction." If the fraction is improper, he converts it to a mixed number. Players use a pencil and paper to convert the improper fractions to mixed numbers.
- Player one goes through all the remaining black cards in turn until all the black cards are played. Player two records player one's time on a piece of paper.
- Player two shuffles the black cards and places them facedown above the red cards. He turns over the next red card to get a new denominator. Player one times how long it takes player two to go through all the black cards.

Appendix C (continued)

- The player with the faster times wins the round. The first player to win three rounds wins the game.

Homework Assignment:

- None

Appendix C (continued)

Content Area:
- Geometry

Grade Level:
- Fifth

Targeted Intelligences:
- Bodily/Kinesthetic
- Interpersonal
- Logical/Mathematical
- Verbal/Linguistic

Lesson Objectives:
- Students will clarify and sort various angles to determine acute, obtuse, and right angles.
- Students will create and measure angles using a protractor.

Activity:
- Ask students to describe everything they know about an angle and record all answers on the board.
- Have students make an angle using only their arms. Look at examples and decide on a definition of an angle for the class to use.
- Write acute, obtuse, and right angle on the board, and ask if they can define the terms. If not, show examples of the various types and have the class determine a definition. Use some more examples and have students classify and distinguish the various angles.
- Assess understanding of the three types of angles by having all children show an example of each type of angle with their arms.
- Next, students are placed in small groups and spend ten minutes exploring at each center (see Center Activities).
- Each small group will have a checker, direction reader, materials manager, director and encourager.

Center Activities:
- Center One- Pattern Blocks
  Students will use protractors to measure the angles of pattern blocks. There will be a large set of pattern blocks and a small set of pattern blocks. After measuring, sort the angles of the pattern blocks into categories: acute, obtuse, and right.

Appendix C (continued)

- Center Two- Paper Plate Angles
  Students will attempt to show different angles using two paper plates, one feeding through the other. One student will be director who calls out either a measurement of an angle or the name. The remainder of the students must make that angle with the plates.

- Center Three- Body Angles
  Students will attempt to apply their knowledge of acute, obtuse, and right angles. Their task will be to form different size angles using only their bodies. Each angle may be formed with one or two people. There will be small sheets of paper with directions on which angle to create.

- Center Four- Geo-board Mania
  Students will experiment with the geo-boards to determine how many acute, obtuse, and right angles they can form. Students must categorize each angle when they create it.

- Center Five- Drawing Angles
  Students will draw various angles of their choice using a protractor. They must show one example of each category of angle. If time permits, students may turn one angle into a picture of their choice (house, creature, etc.).

Homework Assignment:

- None

Appendix C (continued)

Center One: Pattern Blocks

Use a protractor to measure the angle of the large and small pattern blocks. Categorize each pattern block below as acute, obtuse, and right.

Acute	Obtuse	Right

Center Two: Paper Plate Angles

The director will call out any measurement of an angle or an angle name. (For example, director may say 130 degrees or acute and the rest of the group makes it.) Show as many acute, obtuse, and right angles as you can. How many did you find?

Appendix C (continued)

Center Three: Body Angles

The materials manager picks one piece of paper out of the cup and reads it. The other four students pick a partner to work with. You are to form the angle listed using only your body. The angle may be formed with one or two people. When completed start the process over with a new person picking.

What did you learn? What did you like?

Center Four: Geo-board Mania

Attempt to represent as many acute, obtuse, and right angles on the geo-board. Try to find more than your neighbor. You must have a different example than your group members.

How many could you find? Illustrate one example of each.

Acute Obtuse Right

Appendix C (continued)

Center Five: Drawing Angles

Use your protractor to draw an example of an acute, obtuse, and right angle. You must include the measurement of your angle. If time permits, turn one of your angles into a picture.

Acute Obtuse Right

Appendix C (continued)

Content Area:
- Geometry

Grade Level:
- Fifth

Targeted Intelligences:
- Bodily/Kinesthetic
- Interpersonal
- Logical/Mathematical
- Naturalist
- Verbal/Linguistic
- Visual/Spatial

Lesson Objective:
- Students will engage in a "Geometry Scavenger Hunt" outside and locate various geometric shapes and lines.

Materials:
- School playground
- List of items to be found
- Clipboard for each pair of students
- Pencils

Activity:
- Arrange students in pairs for the "Geometry Scavenger Hunt."
- Set the boundaries of the search area according to your circumstances.
- Then provide each partnership with a list of items to be found based on the terms taught and items available in the search area.
- Explain that partners must stay together as they search.
- Students should check off any items they find, and for each they must record where the item was found. These records must be specific.
- Set a time limit for the scavenger hunt.
- When time is up, gather the groups together and see how many items were found by each partnership.
- Spot-check accuracy by asking each partnership to share what they wrote about several of its finds.

Homework Assignment:
- None

Appendix D
Kindergarten Multiple Intelligence Mathematics Lesson Plans

Content Area:
- Shape recognition

Grade Level:
- Kindergarten

Targeted Intelligences:
- Bodily/Kinesthetic
- Intrapersonal
- Logical/Mathematical
- Visual/Spatial

Lesson Objective:
- Students will recognize and draw the four basic shapes.

Materials:
- Shaving cream
- Art smocks

Activity:
- The students will use their fingers to spread shaving cream on their tables. The teacher will draw a square on the board and talk about its properties. The students will attempt to copy the shape in the shaving cream with their fingers. The students will then see how many things they can make out of squares in the shaving cream. After the students wipe the squares away, the procedure will be repeated for the circle, triangle, and rectangle.

Homework Assignment:
- None

Appendix D (continued)

Content Area:

- Knowledge of phone number

Grade Level:

- Kindergarten

Targeted Intelligences:

- Intrapersonal
- Logical/Mathematical
- Visual/Spatial

Lesson Objective:

- Students will recognize the correct order of the digits in their phone number.

Materials:

- An envelope for each child containing pre-cut digits of their phone number

Activity:

- The students will take the digits out of their envelope and put them in the correct order. A copy of phone numbers will be provided for those students who need the extra help.

Homework Assignment:

- None

Appendix D (continued)

Content Area:
- Days of the week

Grade Level:
- Kindergarten

Targeted Intelligences:
- Intrapersonal
- Logical/Mathematical
- Musical/Rhythmic

Lesson Objective:
- Students will begin to memorize the days of the week in order.

Materials:
- Knowledge of the theme song from The Addams Family

Activity:
- Sing as follows:

  "Days of the week! (snap, snap)
  Days of the week! (snap, snap)
  Days of the week, days of the week, days of the week! (snap, snap)
  There's Sunday and there's Monday.
  There's Tuesday and there's Wednesday.
  There's Thursday and there's Friday.
  And then there's Saturday.
  Days of the week! (snap, snap)
  Days of the week! (snap, snap)
  Days of the week, days of the week, days of the week!" (snap, snap)
  (repeat)

Homework Assignment:
- None

Appendix E
Data Collection Tools

Parent Survey

	Yes	No
1. Does your child enjoy listening to other people talking?		
2. Does your child like to tell stories?		
3. Does your child enjoy reading books?		
4. Does your child easily add numbers in his or her head?		
5. Does your child ask a lot of questions about how things work?		
6. Does your child enjoy chess, checkers, or logic puzzles?		
7. Does your child prefer to draw pictures rather than tell stories?		
8. Does your child find his or her way around new places easily?		
9. Does your child like to take things apart and then try to figure out how to put them back together?		
10. Does your child like riding a bike, skating, or climbing?		
11. Does your child use a lot of hand gestures and body movement when talking to friends?		
12. Does your child move, tap, or fidget while seated for a long time in one spot?		
13. Does your child enjoy playing a musical instrument?		
14. Does your child cheer him or herself up with songs when they are sad?		
15. Does your child remember the melodies of songs?		
16. Does your child like to work and play with other kids?		
17. Does your child understand how friends are feeling by looking at their faces?		
18. Is your child a natural leader on teams?		
19. Does your child often need a quiet place to work or just be alone?		
20. Is your child independent or strong willed?		
21. Does your child accurately express how he or she is feeling?		
22. Does your child enjoy collecting bugs, flowers, or rocks?		
23. Does your child like to watch the moon, stars, and waves?		
24. Is your child fascinated with one particular thing from nature and wants to learn about it thoroughly?		

Appendix E (continued)

Parent Math Attitude Survey

Statements	Always	Sometimes	Never
My child likes math.			
My child complains of feeling ill during math work.			
My child enjoys hard problems.			
My child does not want help during math.			
My child looks forward to math class.			
My child loves doing math homework.			
My child likes going to the board during math.			
My child thinks math is fun.			
My child finds math difficult.			

Appendix E (continued)

Student Math Attitude Survey

Put a number from 1 to 5 next to each of these statements according to whether it is...

Almost never true, or you have little feeling about it = 1
Sometimes true, or you have some feeling about it =2
Usually true, or you have a definite feeling about it = 3
Almost always true, or you have a strong feeling about it = 4
Always true, or you get a strong emotional reaction = 5

1. I feel an urge to play around, socialize, or stare out the window when math starts.____

2. When I meet students who love math or do it well, I either think they are a little weird or I envy them._____

3. If I am sitting with two students who are talking about math I have an urge to get out of there or do something else._____

4. When math starts I get a physical reaction in my body, like tightening, or tiring._____

5. Being asked to "go to the board" to explain a math idea in a class-even for math I am able to do at my desk-scares me._____

6. I'm not sure I can trust my answers, even on simple problems._____

7. I have a hard time sitting down to start math work outside school._____

8. Math never seems to stick, and after I learn it or even get a good grade on it, I still don't think I know it._____

9. When I'm around a hard math lesson or task, I feel
angry_____ scared_____ stupid_____ tired_____ helpless_____
blank or fuzzy-brained_____

10. In my body, challenging math problems give me:
upset stomach_____ headache_____ sweaty palms_____ drowsiness_____

(Wahl, 1999, p. 51-52)

Appendix E (continued)

Student Math Attitude Survey Scale

If the student wrote no 5s and no more than one 4, and he or she got 24 or less, the student probably feels fairly OK about math, but might need more practice or a little different instruction.

Otherwise here are you math anxiety estimates:

25-35 Some math discomfort and anxiety.

36-45 Quite a bit of fear and discomfort with math.

46-55 Very anxious about math. Talking about and working on this with your teacher, and maybe with another adult you trust will help you a lot.

56-85 You are just about paralyzed by math! You have a lot you can gain from talking it over with your teacher and another adult you trust. It would also help to have your instruction or testing methods changed to make it easier for you to feel comfortable learning math.

(Wahl, 1999, p.51-52)

Appendix E (continued)

Student Survey

	Yes	No
1. Do you enjoy listening to other people talking?		
2. Do you like to tell stories?		
3. Do you enjoy reading books?		
4. Do you easily add numbers in your head?		
5. Do you ask a lot of questions about how things work?		
6. Do you enjoy chess, checkers, or logic puzzles?		
7. Do you prefer to draw pictures rather than tell stories?		
8. Do you find your way around new places easily?		
9. Do you like to take things apart and then try to figure out how to put them back together?		
10. Do you like riding a bike, skating, or climbing?		
11. Do you use a lot of hand gestures and body movement when talking to friends?		
12. Do you move, tap, or fidget while seated for a long time in one spot?		
13. Do you enjoy playing a musical instrument?		
14. Do you cheer yourself up with songs when you are sad?		
15. Do you remember the melodies of songs?		
16. Do you like to work and play with other kids?		
17. Do you understand how friends are feeling by looking at their faces?		
18. Are you a natural leader on teams?		
19. Do you often need a quiet place to work or just be alone?		
20. Are you independent or strong willed?		
21. Do you accurately express how you are feeling?		
22. Do you enjoy collecting bugs, flowers, or rocks?		
23. Do you like to watch the moon, stars, and waves?		
24. Are you fascinated with one particular thing from nature and want to learn about it thoroughly?		

Appendix E (continued)

Kindergarten Student Survey

Name_____

Do you like stories?

Do you like numbers?

Do you like puzzles?

Do you like to wiggle?

Do you like songs and music?

Do you like to play with friends?

Do you sometimes like to play by yourself?

Do you like bugs or flowers?

Appendix E (continued)

Data Collection Form Prior To Action Research

Names	Beginning of Year Test	Report Card Grades	*Participation

*Participation
A=Active
E=Emerging
P=Passive

Appendix E (continued)

Action Research Data Collection Form

Name	Report Card	Chapter Test	*Participation

*Participation
A=Active
E=Emerging
P=Passive

Appendix E (continued)

Data Collection Form Prior To Action Research

Names	Address	Phone Number	Birthday	Days of the Week	Shapes	Counts 10 Objects	Counts to 50

Appendix E (continued)

Action Research Data Collection Form

Names	Address	Phone Number	Birthday	Days of the Week	Shapes	Counts 10 Objects	Counts to 50

Appendix F
Annotated References

The following materials were used to incorporate multiple intelligences strategies throughout the intervention period.

Arnold, E. (1999). The MI Strategy Bank. Tucson, AZ: Zephyr Press, Inc.

Bellanca, J. (1997). Active Learning Handbook for the Multiple Intelligences Classroom. Arlington Heights, IL: IRI/SkyLight Training and Publishing, Inc.

Hall, M.C. (1999). Multiple Intelligences: Teaching Kids the Way They Learn Grade 4. Torrance, CA: Frank Schaffer Publications, Inc.

Overend-Prior, J. (1999). Multiple Intelligences: Teaching Kids the Way They Learn Grade 5. Torrance, CA: Frank Schaffer Publications, Inc.

The Best of Multiple Intelligences Activities. (1999). Westminster, CA: Teacher Created Materials, Inc.

The following materials guided the mathematics curriculum throughout the action research project.

Baratta-Lorton, M. (1976). Mathematics Their Way. Menlo Park, CA: Addison-Wesley Publishing Company.

Bell et al. (1995). Everyday Mathematics. Evanston, IL: Everyday Learning Corporation.

Eicholz et al. (1995). Addison-Wesley Mathematics Grade 3. Menlo Park, CA: Addison-Wesley Publishing Company.

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Manfre et al. (1994). Count On Us: Heath Mathematics Connections. United States of America: D.C. Heath and Company.

The following materials were utilized to supplement geometry instruction.

Adler, D. (1998). Shape Up! New York, NY: Holiday House.

Burns, M. (1994). The Greedy Triangle. New York, NY: Scholastic Inc.

Neuschwander, C. (1997). Sir Cumference and the First Round Table. New York, NY: Scholastic Inc.

Appendix F (continued)

Neuschwander, C. (2001). Sir Cumference and the Great Knight of Angleland. Watertown, MA: Charlesbridge Publishing.

Dodds, D.A. (1994). The Shape of Things. New York, NY: Scholastic Inc.

Dotlich, R.K. (1999). What is Round? New York, NY: Scholastic Inc.

Dotlich, R.K. (1999). What is Square? New York, NY: Scholastic Inc.

Falwell, C. (1992). Shape Space. New York, NY: Scholastic Inc.

The following materials were used to reinforce problem-solving skills.

Ledwon, P. & Mets, M. (2000). Midnight Math. New York, NY: Scholastic Inc.

McGrath, B.B. (2001). Skittles Riddles Math. New York, NY: Scholastic Inc.

Riley, J., Eberts, M., & Gisler, P. (1995). Stand Up Math. Glenview, IL: Good Year Books.

Tang, G. (2002). The Grapes of Math. New York, NY: Scholastic Inc.

The following materials were used to facilitate multiplication instruction.

Hugel, B. (2001). Mighty Fun Multiplication. New York, NY: Scholastic Inc.

Miller, M. & Lee, M. (1998). Times Tunes. New York, NY: Scholastic Inc.

Miller, M. & Lee, M. (1997). The Mega-Fun Multiplication Facts Activity Book. New York, NY: Scholastic Inc.

Pallotta, J. (2002). The Hershey's Milk Chocolate Multiplication Book. New York, NY: Scholastic Inc.

Phillips, H. D. (1997). Multiplication & Division, 35 Hands On Activities. Cypress, CA: Creative Teaching Press, Inc.

Schiro, M. (1995). Mega-Fun Math Games. New York, NY: Scholastic Inc.

The following reference was used for graphing activities throughout the intervention period.

Reed, K. (1999). Data & Graphing Activities For Every Month. Alsip, IL: Ideal School Supply Company.

Appendix F (continued)

The following book was used to introduce the concept of one million.

Schwarz, D. (1985). How Much Is A Million? New York, NY: Lothrop, Lee & Shepard Books.

The following book provided numerous fraction activities during the action research project.

Long, L. (2001). Fabulous Fractions. New York, NY: John Wiley & Sons, Inc.

The following materials were used for counting instruction.

Anno, M. (1975). Anno's Counting Book. New York, NY: Scholastic Inc.

Anholt, C. & L. (1993). One, Two, Three, Count With Me. New York, NY: Scholastic Inc.

Bang, M. (1983). Ten, Nine, Eight. New York, NY: Greenwillow Books.

Base, G. (2001). The Water Hole. New York, NY: Harry N. Abrams, Inc.

Brusca, M. & Wilson, T. (1995). Three Friends. New York, NY: Scholastic Inc.

Crews, D. (1986). Ten Black Dots. New York, NY: Scholastic Inc.

Edwards, P. D. (2000). Roar! New York, NY: Scholastic Inc.

Falwell, C. (1993). Feast for 10. New York, NY: Scholastic Inc.

Hutchings, A. & R. (1997). The Gummy Candy Counting Book. New York, NY: Scholastic Inc.

Kirk, D. (1997). Miss Spider's Tea Party. New York, NY: Scholastic Inc.

MacDonald, S. (2000). Six Little Frogs. On Watermelon Pie and Other Tunes! [Medium of recording: compact disc.] San Antonio, TX: Grasshopper Press.

McGrath, B. B. (1998). The Cheerios Counting Book. New York, NY: Scholastic Inc.

McGrath, B. B. (1994). The M & M's Counting Book. New York, NY: Scholastic Inc.

Moss, L. (1995). Zin! Zin! Zin! A Violin. New York, NY: Aladdin Paperbacks.

Appendix F (continued)

O'Conell, J. (2000). Ten Timid Ghosts. New York, NY: Scholastic Inc.

O'Keefe, S. H. (1989). One Hungry Monster. New York, NY: Scholastic Inc.

Sabuda, R. (1997). Cookie Count. New York, NY: Simon & Schuster.

Scarry, R. (1978). Little Counting Book. New York, NY: Random House, Inc.

Scelsa, G. & Millang, S. (1978). The Number Rock [Greg Scelsa]. On We All Live Together [Medium of recording: compact disc]. Los Angeles, CA: Little House Music.

Smith, M. (1997). Peas and Potatoes, 1, 2, 3. Austin, TX: Steck-Vaughn Company.

Szekeres, C. (2000). Learn to Count Funny Bunnies. New York, NY: Scholastic Inc.

Walton, R. & Miglio, P. (1998). So Many Bunnies. New York, NY: Scholastic Inc.

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